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1. REPORT NUMBER		2. GOVT ACCESSION NO.		3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle)		5. TYPE OF REPORT & PERIOD COVERED			
HUMAN FACTORS PROBLEMS OF THE COMMAND, CONTROL, AND COMMUNICATION PROCESS IN THE 1990's		Interim Technical Report, 2 March - 13 July 1976			
6. AUTHOR(s)		7. CONTRACT OR GRANT NUMBER(s)			
R. Hayes, J. Brownell, J. Hayes, B. Spector		MDA903-76-C-0219, NEW			
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS			
CACI, Inc.-Federal 1815 North Fort Myer Drive Arlington, Virginia 22209		ARPA Order 3201 Program Code No. 0D20			
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE		13. NUMBER OF PAGES	
Defense Advanced Research Projects Agency Cybernetics Technology Office 1400 Wilson Boulevard, Arlington, Va. 22209		14 Jul 1976		79	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)			
		Unclassified			
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE			
16. DISTRIBUTION STATEMENT (of this Report)					
Approved for Public Release, Distribution Unlimited					
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)					
18. SUPPLEMENTARY NOTES					
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)					
C ³ Future Environments Human Factors Forecasting 1990's					
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)					
This report describes research completed on the first four tasks of the study. Two quite different descriptive structures are built that will interact in subsequent tasks to provide the study outcome. First, a set of human factors activities involved in the C ³ process is enumerated and the determining forces controlling these human factors are elaborated. Second, a list of variables constituting the set of relevant dimensions of future (1990) environments for C ³ centers is developed, and, by analyzing the literature and exploring expert					

opinion, values for these variables are specified which in aggregate constitute meaningful alternative futures.

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INTERIM TECHNICAL REPORT

Covering Tasks 1-4

"Human Factors Problems of the C³
Process in the 1990's"

ARPA Order Number:	3201
Program Code Number:	6D20
Contractor:	CACI, Inc. -Federal
Effective Date of Contract:	2 March 1976
Contract Expiration Date:	15 September 1976
Amount of Contract:	\$115,678
Contract Number:	MDA903-76-C-0219
Principal Investigator:	Dr. Richard E. Hayes (703) 841-7800
Short Title of Work:	Human Factors in C ³
Date of Report:	14 July 1976
Period Covered by Report:	2 March-13 July 1976

This research was supported by the Defense Advanced Research Projects Agency under ARPA Order No. 3201; Contract No. MDA903-76-C-0219.

SUMMARY OF TASKS 1-4

INTRODUCTION

The first four tasks of this study build two quite different descriptive structures that interact in subsequent tasks to provide the study outcome. Tasks 1 and 2 produced the set of human factors activities involved in the C^3 process and the set of determining forces controlling these human factors activities. Tasks 3 and 4 produced the list of variables constituting the set of relevant dimensions of future (1990) environments for the C^3 centers, and, by analyzing the literature and exploring expert opinion, developed those values for the variables, which in aggregate constitute meaningful alternative futures.

HUMAN FACTORS AND DETERMINANTS THEREOF

Fifty human factors were developed and categorized according to

- Background Factors,
- Cognitive and Mental Factors,
- Motivational Factors,
- Interpersonal and Organizational Factors, and
- Physiological Factors.

The 30 most important and well-defined (in the scholarly literature) of these human factors were described in terms of determining forces

and consequences. The determining forces are those environmental or internal conditions that are individually sufficient to arouse or activate the human factor. The consequences are those conditions or events resulting from arousing the particular human factor under consideration. Annex 1 lists the 30 most pertinent human factors, their determinants, and their consequences. The determinants and consequences are causally linked to the human factors in a positive or negative relationship, as indicated in Annex I by "+" and "-", respectively.

RELEVANT DIMENSIONS OF AND MEANINGFUL ALTERNATIVES IN THE FUTURE (1990's) ENVIRONMENT

In consultation with ARPA personnel, a list of 155 variables was prepared and organized under the following hierarchical framework of dimensions:

- People differences
 - Selection for service
 - Enhancement in service
- Machine characteristics
 - Computers
 - Communications
 - Physical environment
- Within-center dynamics
 - Decision-maker functions
 - Other functions
 - Multinational centers

- C³ center-to-world interface with the
 - C³ center system
 - Armed services
 - United States
 - World

Based on the coding of approximately 100 sources in the literature and discussions with approximately a dozen experts, values were given to these variables and appropriate clustering techniques applied to provide a basis for the next task selection of interesting 1990's environments. The variable values were assigned both on the basis of probability of occurrence and, in some indicated cases, on the basis of their being possible (rather than probable), significant, and different. Annex II lists 92 single valued values. Annex III lists 54 dichotomous values, and 9 multivalued variables are shown in Annex IV.

ANNEX I

THE DETERMINING FORCES AND CONSEQUENCES OF EACH HUMAN FACTOR

In this section, the determinants and consequences of each human factor are examined in a preliminary fashion. Thirty of the 50 factors in the original working list are included. Those human factors reviewed in this section are considered to be among the most important to C^3 functioning. Among the factors omitted from this section are those considered to have a lesser impact on C^3 operations or to be less clearly defined in the scholarly literature.

Research literature in psychology, sociology, and other relevant disciplines was reviewed as source material. Because of the enormous amount of literature that exists on each human factor, summary and review articles or books, as well as integrative classics, were referenced to develop lists of those forces causally related to each factor. Generally established, commonly accepted, and replicated research results or theories form the data base for this section.

The examination of each human factor is divided into a determining forces and a consequences section. The determining forces can be defined as those environmental or internal conditions that are individually sufficient to arouse or activate the human factor. The consequences are those conditions or events that result from arousing the particular human factor under consideration. The occurrence of each consequence may be contingent upon particular intervening circumstances that are specified. The determinants and consequences are causally linked to the human factor in a positive or negative relationship, denoted by a "+" or "-", respectively. An implicit assumption in each causal path is the constancy or nonarousal state of all

other human factors. The interaction effect among human factors has generally not received adequate consideration in the literature to allow accurate discrimination of the determinants or consequences of several human factors in combination.

HUMAN FACTORS: AGE (BI)

Determining Forces

1. (+) Requirements for particular skills or experience.
2. (+) Promotions late in one's career.
3. (-) Lowered retirement age.
4. (-) Increased pension for fewer years of service.

Consequences

1. (+) Ability to anticipate, deal with, and react to recurrent and new situations (unless there are organic failures).
2. (+) Tendency toward accuracy rather than speed in sensory-motor activity.
3. (+) Performance level (if tasks demand knowledge and experience).
4. (+) Performance level (if individual overcompensates).
5. (-) Performance level up to subjectively desired standard of achievement.
6. (-) Performance level (if tasks demand organic capacities).
7. (-) Capacity and control over action.
8. (-) Problem-solving performance due to limitations on load of short-term memory capacity and the gathering and coding of incoming data (not inability for intellectual leaps or insight).
9. (-) Perceptual discrimination.
10. (-) Ability to learn or remember.

11. (+) Unwillingness to take risks.
12. (+) Tendency to partially compensate for loss of capacity by changes in method of action.
13. (-) Expectations and level of aspiration regarding level of performance possible.
14. (+) Rigidity to certain modes of response regardless of situation (for example, stereotyping).
15. (+) Hesitation due to inability to choose appropriate alternatives (for example, lack of confidence).
16. (+) Frustration because of inability to cope with social demands.

Sources: Kogan and Wallach, 1964; Welford, 1973.

HUMAN FACTOR: PERCEPTUAL RIGIDITY (CI)

Determining Forces

1. (+) Psychologically stressful or threatening situation.
2. (+) Highly valued or emotional situation.
3. (+) Threat-induced anxiety.
4. (+) Need for social approval.
5. (+) Conformity to group norms.
6. (+) Overidentification with absolute authority or a cause.
7. (+) Pressures of reward or punishment from external social or cultural authorities.
8. (+) Activation of cognitive defense mechanisms against anxiety.

Consequences

1. (+) Premature closure (new stimuli that challenge established beliefs are selectively ignored or reinterpreted).
2. (+) Response time (if new information is presented gradually).
3. (-) Response time (if new information is presented all at once).
4. (+) Resistance to extinguishing inappropriate responses.
5. (-) Ability to distinguish new information that is true.
6. (+) Credibility of biased sources of information.
7. (-) Number of potential and viable alternatives.
8. (+) Tendency to view world and events as threatening.

disagree with authority.

10. (+) Tendency to be dogmatic, intolerant, and authoritarian.
11. (+) Tendency to feel alone, isolated, helpless, and inadequate.
12. (+) Anxiety.
13. (-) Ability to synthesize new information.
14. (-) Ability to recall beliefs and opinions other than one's own.

Sources: Cowen, 1952; Janis and Terwilliger, 1962; Milburn, 1963; Moffitt and Stagner, 1956; Rokeach, 1960; Tajfel, 1969.

HUMAN FACTOR: MEMORY (C2)

Determining Forces

1. (+) Stimulus or opportunity that cues the need for learned information.
2. (+) Practice.
3. (+) Use of natural language mediators as an associative device.
4. (+) Meaningfulness of material to individual.
5. (+) Degree to which material was originally learned.
6. (+) Familiarity with learned material (in recognition tasks).
7. (+) Internal or external reinforcement.
8. (+) Removal of individual from interfering events during retention interval (for example, through sleep or sensory deprivation).
9. (-) Time.
10. (-) Fatigue.
11. (-) Learned material that has a negative emotional significance to the individual.
12. (-) Competing, similar material that inhibits learned responses (proactive and retroactive inhibition).
13. (-) Drive to internal consistency or new external stimulation that causes a transformation during the retention interval.

Consequence

1. (+) Ability for accurate responding (recall or recognition).

Sources: Adams, 1967; Morgan and King, 1966.

HUMAN FACTOR: CAPACITY FOR LEARNING (C5)

Determining Forces

1. (+) Systematic association of reinforcing events, the criterion response, and the stimulus.
2. (+) Reinforcement (conditioning).
3. (+) Strong motivational states (for example, anxiety) if learning task is simple.
4. (+) Meaningfulness of material to be learned.
5. (+) Similarity of learned material to past learned material.
6. (+) Frequency of presentation of new material (practice).
7. (+) Feedback of results.
8. (+) Learning sophistication from previous experience.
9. (-) Interference from other learned material.

Consequences

1. (+) Ability to adapt to new situations.
2. (+) Ability to habituate appropriate responses.
3. (+) Reductions of error.

Sources: Adams, 1967; Kintsch, 1970; Mednick, Pollio, and Loftus, 1973; Morgan and King, 1966.

Determining Forces

1. (+) Perceived expertise, prestige, or admiration of source of information.
2. (+) Perceived objectivity of source.
3. (+) Assumption of nondeceptive intent of source.
4. (-) Ambiguous information.
5. (+) Ambiguous information (if individual has high confidence in credibility of information).

Consequences

1. (+) Propensity to attitude change (openness to persuasion).
2. (-) Increased reliance on social and group norms to identify accurate information.
3. (-) Anxiety.

Sources: Berkowitz, 1969; Feldman, 1966; McGuire, 1969; Tajfel, 1969.

HUMAN FACTOR: INDIVIDUAL CREATIVITY (C8)

Determining Forces

1. (+) Adaptive and spontaneous flexibility.
2. (+) Associational and ideational fluency.
3. (+) Ability to redefine and strive for more comprehensive answers.
4. (+) Ability for divergent and convergent thinking.
5. (+) Capacity to be puzzled and sense ambiguities.
6. (+) Resistance to idea reduction and broadly diffused attention.
7. (+) Resistance to premature closure.
8. (+) Curiosity.
9. (+) Tolerance for ambiguity.
10. (+) Need for individual recognition.
11. (+) Need for autonomy.
12. (+) Preference for complexity.
13. (+) Role playing.
14. (+) Hypnosis.
15. (+) Psychotherapy.
16. (+) Consciousness changing drugs.
17. (+) Biofeedback.
18. (+) Diverse, simultaneous sensory stimulation.

Consequences

1. (+) Increased probability to take calculated and realistic risks.
2. (+) Stimulation to group problem-solving process.
3. (+) Ability to find alternative paths to overcome social and group obstacles.

Sources: Taylor and Holland, 1964; Stein, 1975.

HUMAN FACTOR: INDIVIDUAL MORALE (M1)

Determining Forces

1. (+) Central rather than peripheral position in communications network.
2. (+) Permissive leadership (if group is democratically oriented).
3. (+) Considerate leadership (if group is small, that is, less than 10).
4. (+) Authoritarian leadership (if group is autocratically oriented).
5. (+) Task-oriented leadership (if group is large, that is, greater than 10).
6. (+) Reference group identification.
7. (+) Group cohesiveness.
8. (+) Praise from others in or observing group.
9. (+) Feedback.
10. (+) External crisis.
11. (-) Peripheral location in communication network (if individual has high need for autonomy or power).
12. (-) Within-group antagonism or crisis.
13. (-) Dull or routine tasks.
14. (-) Little understanding of task or group objectives.
15. (-) Reducing opportunity for interpersonal communication within group.

Consequences

1. (+) Ability to withstand external attack and strain to group.
2. (-) Apathy.
3. (-) Hostility and aggression.

Sources: Berkowitz, 1969; Collins and Raven, 1969; Gibb, 1969; Kelley and Thibaut, 1969.

HUMAN FACTOR: REFERENCE GROUP IDENTITY (M2)

Determining Forces

1. (+) Need for social comparison of one's ideas.
2. (+) Need for social evaluation of self-worth (need for social approval).
3. (+) Need for affiliation with those who can aid in self-understanding.
4. (+) Compatibility between individual values and perceived group values.
5. (+) Desire for identification with an attractive group.
6. (+) Capacity of group to confer rewards on individual.
7. (+) Moderate stress.
8. (+) Fear.
9. (+) External crisis.
10. (-) Within-group crisis or antagonism.

Consequences

1. (+) Conformity to group values and norms.
2. (+) Confirmation (approval) and validation of individual values and role.
3. (+) Individual satisfaction and morale.
4. (+) Responsible task performance.
5. (+) Positive evaluation of others in group.

6. (+) Within-group communication
7. (+) Within-group interpersonal influence.

Sources: Berkowitz, 1969; Collins and Raven, 1969; Kelley and Thibaut, 1969; Morgan and King, 1966; Sarbin and Allen, 1968.

HUMAN FACTOR: TASK ACCEPTANCE (M3)

Determining Forces

1. (+) Participation in developing task parameters.
2. (+) Belief in legitimacy of decision-maker.
3. (+) Belief in expertise of decision-maker.
4. (+) Accordance of deference to decision-maker.
5. (+) Task is in accordance with past actions.
6. (+) Task is within range of social or group acceptable norms.

Consequences

1. (+) Effectiveness of final decision implementation.
2. (+) Individual initiative, judgment, and creativity.

Sources: French and Raven, 1959; Vroom and Yetton, 1973.

HUMAN FACTOR: NEED FOR COGNITIVE CONSISTENCY (M6)

Determining Forces

1. (+) Striving toward a balanced (nonambivalent) state (if inconsistent cognitions are significant to individual).
2. (+) Desire for certainty.
3. (+) Desire for confirmation of one's beliefs.
4. (+) Desire for accurate communications with others.
5. (+) Presentation of inconsistent or contradictory information.
6. (+) Increase in number and quality of alternatives from which to choose.
7. (+) Increase in pressures from conflicting role demands and social norms.
8. (+) Disconfirmed expectations (anticipating events that never occur).
9. (+) Insufficient justification (lack of adequate cognitive support for actions).
10. (+) Postdecision dissonance (misgivings that selected alternative was not optimal).

Consequences

1. (+) Reevaluate old cognitions in light of new, contradictory information (that is, attitude change) (if not highly committed to former cognitions).
2. (+) Seek new information to achieve accuracy (if not highly committed to former cognitions).
3. (+) Seek new information to confirm former cognitions (if highly committed to former cognitions).

4. (+) Persuade source of conflicting information to change position (if highly committed to former cognitions).
5. (+) Escape or withdrawal (if highly committed to former cognitions).

Sources: Berkowitz, 1969; Kelley and Thibaut, 1969; Zajonc, 1968.

HUMAN FACTOR: TOLERANCE FOR AMBIGUITY (M7)

Determining Forces

1. (+) Flexible and open belief system.
2. (-) Rigid defensiveness.
3. (-) Desire to be in control.
4. (-) Anxiety in stressful situations.

Consequences

1. (+) Tendency toward cooperative behavior.
2. (+) Autonomy of thought.
3. (+) Readiness and openness for cognitive reassessment and adjustment.
4. (+) Acceptance of the complexity and uncertainty of reality.
5. (+) Openness to conflicts, doubts, and indecision.
6. (+) Readiness to think over problems.
7. (+) Preference for change, imbalance, and abstractness.
8. (-) Assumption that one has a valid understanding of the situation.
9. (-) Conformity to dogma and fixed concepts or ideals.
10. (-) Preconceptions or prejudgments.

Sources: Berkowitz, 1969; Frenkel-Brunswik, 1950; Rubin and Brown, 1975.

HUMAN FACTOR: NEED FOR APPROVAL AND PERFORMANCE FEEDBACK (M8)

Determining Forces

1. (+) Desire to know consequences of one's actions (that is, success or failure).
2. (+) Desire for social desirability.
3. (+) Deprivation of approval, feedback, or reinforcement.
4. (+) Low self-esteem.
5. (+) Expectation of social rejection or threat to self-esteem.
6. (+) Defensiveness against hostility.
7. (+) Need for affiliation.
8. (+) Competitive environments.

Consequences

1. (+) Seek approval, feedback, reinforcement, and evaluative reward.
2. (+) Dependent, passive behavior.
3. (+) Acquiescence.
4. (+) Conformity to situational demands and group pressures.
5. (+) Responsiveness to social reinforcement.
6. (+) Compliance to persuasion (prone to change attitudes).
7. (-) Expression of aggression.
8. (+) Caution in setting goals in risky situations.
9. (+) Favorable attitudes toward dull and boring tasks.

Sources: Crowne and Marlowe, 1964; Kelley and Thibaut, 1969; Lazarus, 1970; Marlowe and Gergen, 1969.

HUMAN FACTOR: NEED FOR ACHIEVEMENT (M9)

Determining Forces

1. (+) Expectation that certain behaviors are instrumental in accomplishing something of value or pleasure to individual.
2. (+) Subjective probability of immediate success.
3. (+) Subjective importance of success.
4. (+) High level of aspiration.
5. (+) Tendency to avoid failure.
6. (+) Tasks requiring competent performance with uncertainty of mastery.
7. (+) Competitive environment.

Consequences

1. (+) Increased performance on tasks of intermediate difficulty.
2. (+) Increased performance (if in noncompetitive or non-public situations).
3. (+) Increased trusting of others and trustworthy cooperative behavior in competitive bargaining situations.
4. (+) Persistence at tasks that were initially perceived as easy.
5. (+) Moderate risk-taking (if task achievement has no future implications).
6. (+) Conservative risk-taking (if individual is striving for future success).
7. (-) High risk-taking (if individual has unrealistic aspirations).

8. (+) High conformity (if success requires dependence on others).
9. (+) Low conformity (if success can be obtained through independent action).
10. (+) Cheating behavior.
11. (+) Seeking positive reinforcement for demonstrated competence.
12. (+) Anxiety.
13. (+) Intense self-aggression and guilt.
14. (+) Proneness to muscular tension and psychosomatic ailments.

Sources: Atkinson, 1974; Berkowitz, 1969; Horner, 1974; Karabenick and Youssef, 1974; Kelley and Thibaut, 1969; Marlowe and Gergen, 1969; Raynor, 1974; Raynor, Atkinson, and Brown, 1974; Siegel and Fouraker, 1960; Terhune, 1970; Zigler and Child, 1969.

HUMAN FACTOR: PROPENSITY FOR RISK-TAKING (MI 0)

Determining Forces

1. (+) Individual tolerance for error and failure.
2. (+) Extremity in making judgmental estimates.
3. (+) High confidence in one's own judgment.
4. (+) Individual need for achievement (if task involves skill rather than chance).
5. (+) Need for autonomy.
6. (+) Failure in prior tasks.
7. (+) Diffusion of responsibility in a group.
8. (-) Need for internal control.
9. (-) High degree of prior success.
10. (-) Manifest anxiety and rigidity.
11. (-) Age of individual.

Consequences

1. (+) Enhanced decision-making performance (if individual has low anxiety and defensiveness).
2. (+) Enhanced performance in verbal aptitude domain.
3. (+) Post-decision satisfaction.
4. (+) Increased degree of persuasiveness.

Sources: Kelley and Thibaut, 1969; Kogan and Wallach, 1964.

HUMAN FACTOR: BOREDOM (M11)

Determining Forces

1. (+) Repetitive, monotonous tasks.
2. (+) Superior intelligence.
3. (+) Tendency to extroversion.
4. (-) Anticipation of end of monotonous work period.
5. (-) Ability to make a repetitive task automatic, freeing one's mind for other things.
6. (-) Understanding of reason or meaning of task.
7. (-) Establishment of intermediate subgoals.
8. (-) Increased incentive.
9. (-) Rest periods.
10. (-) Novelty.

Consequences

1. (+) Fatigue.
2. (+) Productivity decrement.
3. (-) Speed of performance.
4. (+) Errors.
5. (+) Restlessness and strain.
6. (-) Vigilance.
7. (-) Morale.

8. (-) Job interest.

9. (+) Extraneous aggressive behavior.

Source: Maier, 1965.

HUMAN FACTOR: FRUSTRATION (MI2)

Determining Forces

1. (+) Unexpected deprivation of anticipated goals.
2. (+) Environmental obstacles to goal attainment.
3. (+) High level of aspiration but low personal capacity to achieve it (personal failure).
4. (+) Internal conflict of motives.

Consequences

1. (+) Readiness for aggressive behavior.
2. (+) Anger.
3. (+) Vacillation.
4. (+) Fear and anxiety.
5. (+) Escape.
6. (+) Behavioral rigidity that interferes with innovative problem-solving.
7. (+) Group disintegration (if group is unorganized).
8. (+) Search for alternative behavior to achieve goal.
9. (+) Ingroup feeling (if group is highly organized).
10. (-) Task performance.

Sources: Berkowitz, 1969; Kelley and Thibaut, 1969; Morgan and King, 1966.

HUMAN FACTOR: FEAR (M13) .

Determining Forces

1. (+) Anticipation of pain (threats) from an objectively harmful source.
2. (+) Severe deprivation and discomfort from stressful stimulus.
3. (+) Sudden, unexpected, or strange stimulus.
4. (+) Anticipation of own failure.

Consequences

1. (+) Increased within-group integration and cohesion (increased affiliative drives).
2. (+) Avoidance (escape) behavior (if situational or internalized constraints on or costs of avoidance behavior are weak).

Sources: Berkowitz, 1969; Lazarus, 1966; Morgan and King, 1966.

HUMAN FACTOR: ANGER (M14)

Determining Forces

1. (+) Stressful or threatening stimuli that are provoking or thwarting.
2. (+) Frustration (if above individual's subjective tolerance level).
3. (+) Restraints or deprivations.
4. (+) Situations of inferiority and loss of prestige.
5. (+) Alarming or annoying sound, touch, or visual perceptions.
6. (+) Recall of stimuli that have caused anger in the past.

Consequences

1. (+) Attack and aggressive behavior (if situational, or internalized constraints, and costs of attack behavior are weak).
2. (+) Goal achievement (if anger influences source of rewards).
3. (+) Defensive repression of anger response (if it is internally abhorrent).
4. (+) Depression (if anger is denied).
5. (+) Sensory and motor manifestations such as restlessness or headaches (if anger is suppressed).
6. (+) Physiological reactions, such as increase in heart rate, blood pressure, and acidic secretion in the stomach.

Sources: Lazarus, 1966; Madow, 1972; Morgan and King, 1966; Stearns, 1972.

HUMAN FACTOR: ANXIETY (M15)

Determining Forces

1. (+) Stressful stimulus with no harmful agent identified.
2. (+) Generalization of specific fear-provoking experiences to other contexts.
3. (+) Imagined or anticipated fear-provoking situations.
4. (+) Fear of what might occur if one expresses feelings or impulses.
5. (+) Impending failure.
6. (+) Social frustration of dependency needs.

Consequences

1. (+) Effective performance (at moderate levels of anxiety).
2. (+) Potential creativity (at moderate levels of anxiety).
3. (+) Muscular tension.
4. (-) Problem-solving ability.
5. (-) Incidental learning ability.
6. (-) Ability to communicate or comprehend.
7. (-) Cognitive performance (if speed is crucial).
8. (-) Number of responses perceived to be available (if task is difficult).

Sources: Lazarus, 1966; Levitt, 1967; Morgan and King, 1966.

HUMAN FACTOR: NUMBER OF PARTICIPANTS IN ACTIVITY
AREA (N1)

Determining Forces

1. (+) Requirements for diverse staff skills and experience.
2. (+) Problem size and complexity.
3. (+) Need to staff machines and perform tasks successfully.

Consequences

1. (+) Increased yielding to conformity pressure.
2. (-) Group cohesiveness.
3. (+) Development of subgroups and factions.
4. (+) Individual dissatisfaction with own role in organization.
5. (+) Expression of dissatisfaction.
6. (+) High morale (if leader is task-oriented).
7. (+) Demands on leadership.
8. (+) Wider span of control.
9. (+) Increased division of labor.
10. (-) Opportunity for staff to interact and exhibit leadership behavior.

Sources: Blau, 1974; Gibb, 1969; Thomas and Fink, 1969.

HUMAN FACTOR: TEAMWORK (N2)

Determining Forces

1. (+) Requirements for diverse staff skills and experience.
2. (+) Problem size and complexity.
3. (+) Need for integration of diverse ideas and information.
4. (+) Need to reduce leader workload.
5. (+) Need for innovative solutions.

Consequences

1. (+) Individual sensitivity to relevant cues (alertness).
2. (+) Individual motivation for performance (morale, sense of efficacy, job satisfaction).
3. (-) Fatigue.
4. (+) Individual performance speed.
5. (+) Individual learning from example and observation.
6. (+) Performance of individual overt tasks (such as writing).
7. (+) Group creative problem-solving (if leader allows expression and discussion of minority opinion).
8. (+) Reduced reaction time (if routine problems).
9. (+) Opened communication networks within organization.
10. (+) Drive to groupthink (consensus, uniformity).
11. (-) Individual initiative.

12. (+) Individual error-making due to distractions.
13. (+) Individual caution and conservative behavior.
14. (+) Probability of risky decisions taken by group.
15. (-) Individual intellectual reasoning and judgmental tasks.
16. (+) Increased reaction time (if new and nonrecurrent problems).
17. (+) Time to develop informal problem-solving process in the group.

Sources: Blau, 1974; Carlisle, 1974; Kelley and Thibaut, 1969; Simon, 1954; Tajfel, 1969.

HUMAN FACTOR: INTERPERSONAL TRUST (N6)

Determining Forces

1. (+) Perception of other's altruistic intentions.
2. (+) Prior beneficial actions by other.
3. (+) Possession of similar sentiments or ideologies with other.
4. (+) Open communication with other.
5. (+) Faith and confidence in other.
6. (+) Presence of mutually trusted third party.
7. (+) Innocence.
8. (+) Virtuosity.
9. (+) Impulsiveness.
10. (+) High risk-taking potential.
11. (+) Masochism.
12. (+) Conformity to social expectations.
13. (+) Expectation of despair or loneliness.
14. (-) Competitive situation.

Consequences

1. (+) Trustworthy cooperative behavior.

Sources: Deutsch, 1973; Kelley and Thibaut, 1969.

HUMAN FACTOR: DISTRIBUTION OF AUTHORITY (N8).

Determining Forces

1. (+) Leader trust and confidence in staff.
2. (+) Staff has direct access and control over information and skills (dispersed communication and information channels).
3. (+) Unstructured problem.
4. (+) Ambiguous mission goals.
5. (+) Nonstressful missions.
6. (+) Leadership that is considerate and relations-oriented.
7. (+) Leader desire for development of subordinate responsibility.
8. (+) Requirement for staff acceptance of task.
9. (+) Staff questioning of autocratically derived decisions.
10. (+) Existence of large screen displays.
11. (-) Existence of sophisticated decision aids.
12. (-) Within-group conflict.

Consequences

1. (+) Increased contribution and responsibility of staff specialists.
2. (+) Increased job satisfaction, morale, and sense of efficacy among staff.
3. (+) Innovative solutions to problems.

4. (+) Flexibility in types of reactions.
5. (+) Reduced workload for top management.
6. (+) Reduced reaction time on routine tasks.
7. (+) Increased reaction time on unusual tasks.
8. (+) Coordination problems.
9. (+) Leadership problems and role conflicts in team.
10. (+) Propensity to risky-shift in group.

Sources: Blau, 1974; CACI, 1976; Carlisle, 1974; DeCarlo, 1967; Gibb, 1969; Kelley and Thibaut, 1969; Lawrence and Lorsch, 1967; Simon, 1954; Vroom and Yetton, 1973.

HUMAN FACTOR: SPAN OF CONTROL (N9)

Determining Forces

1. (+) Automation of operations.
2. (+) Increased number of personnel at lower levels of hierarchy.
3. (-) Increased number of professionals and experts on staff.
4. (-) Increased differentiation of tasks.
5. (-) Increased complexity of tasks.
6. (-) Increased division of labor.

Consequences

1. (+) Economies in total man-hour costs.
2. (+) High performance at lower levels of hierarchy (in industrial plants).
3. (+) Better communications, opportunities for individual growth and initiative, and higher morale.
4. (-) Increased professional work by managers so they can communicate adequately with professional staff.

Sources: Blau, 1974; Porter and Lawler, 1969.

HUMAN FACTOR: EFFECTIVE LEADERSHIP STYLES (N10)

Determining Forces

1. (+) Relations-oriented style (if the leader has a minimal power position, is accepted as the legitimate leader, and has an unstructured task).
2. (+) Democratic style (if subordinates are given opportunities for self-actualization and need satisfaction).
3. (+) Participatory style (if subordinate cooperation and support is critical and subordinates possess crucial information and expertise).
4. (+) Considerate style (if group is small).
5. (+) Task-oriented style (if the leader has power, the informal backing of subordinates, and a relatively well-structured task).
6. (+) Task-oriented style (if the leader does not have power, is not accepted by subordinates, and has an ambiguous and indefinite task).
7. (+) Autocratic style (if subordinate acceptance of task or decision is not essential).
8. (+) Authoritarian style (if group is large).

Consequences

1. (+) Increased productivity.
2. (+) Increased quality of output.
3. (+) Increased reaction time.
4. (+) Increased capacity to evaluate problem and respond effectively.

5. (+) Increased morale of subordinates.
6. (+) Increased acceptance of decisions by subordinates.

Sources: Fiedler, 1967, 1965; Korman, 1969; McCormick, 1970; U.S. Army Advanced Material Concepts Agency, 1970; Vroom and Yetton, 1973.

HUMAN FACTOR: VISUAL DISCRIMINATION (P1)

Determining Forces

1. (+) Size of object.
2. (+) Intensity of light on object.
3. (+) Contrast between object and background.
4. (+) Ambient illumination.
5. (+) Duration of object's presence.
6. (+) Saturation or purity of color.
7. (+) Colors nearer center of visible spectrum.
8. (-) Distance of person from object.

Consequences

1. (+) Ability to detect and perceive differences in visual signals.

Sources: Fogel, 1967; Morgan and King, 1966.

HUMAN FACTOR: AUDITORY DISCRIMINATION (P2)

Determining Forces

1. (+) Frequency range of 500-10,000 cycles per second.
2. (+) Intensity level above 20 decibels.
3. (-) Signal duration of less than one-hundredth of a second.
4. (-) Diffuseness of spectral properties of sound signal.
5. (-) Distance of sound source from individual.
6. (-) Masking of sound.

Consequences

1. (+) Ability to detect and perceive differences in auditory signals.

Sources: Fogel, 1967; Morgan and King, 1966.

HUMAN FACTOR: TACTILE DISCRIMINATION (P3)

Determining Forces

1. (+) Vibratory frequency range of 250-8,000 cycles per second.
2. (+) Rapid application of pressure stimuli.
3. (+) Change in pressure stimulus.
4. (-) Weak pressure stimulus.
5. (-) Continuously applied pressure stimuli that remain undisturbed.

Consequences

1. (+) Ability to detect and perceive differences in tactual signals.

Source: Fogel, 1967.

HUMAN FACTOR: VIGILANCE (P5)

Determining Forces

1. (+) Expectancy of signal occurrence.
2. (+) Frightening or ambiguous danger signals from environment.
3. (+) Feedback on level of performance.
4. (+) Increased punishment for false alarms.
5. (+) Task significance to individual.
6. (+) Rest pauses.
7. (+) Stimulant drugs.
8. (-) Low probability of signal occurrence.
9. (-) Monotony and boredom.
10. (-) Time.

Consequences

1. (+) Accurate signal detection.
2. (+) Increased sensitivity to signal occurrence.
3. (+) False alarms (if task requires division of attention).
4. (+) Sharp decrement in accurate signal detection (if signal rate increases).
5. (+) Increased performance (if auditory rather than visual signals).

6. (+) Increased performance (if redundant auditory and visual signals).
7. (+) Increased performance with time (if task involves detection of relevant signals from complex sensory field).
8. (+) Decreased performance with time (if task emphasizes speed of signal detection).

Sources: Berkowitz, 1969; Levine, Romashko, and Fleishman, 1973; Mackworth, 1970.

HUMAN FACTOR: FATIGUE (P6)

Determining Forces

1. (+) Deprivation of primary needs.
2. (+) Satiation of secondary drives.
3. (+) Boredom, routine, and monotony.
4. (+) Longevity of task.
5. (+) Exceedingly heavy muscular work, strain, or exertion.
6. (+) Rate of working.
7. (+) Amount of work done.
8. (+) Inadequate ventilation and high temperatures.
9. (+) Intensely competing stimuli (information overload).
10. (+) Frustration.
11. (+) Anticipation of stressful and threatening situations.
12. (+) Longevity of stressful situations.
13. (+) Initial exposure to stressful, life threatening situations.
14. (-) Rest pauses.
15. (-) Rotation of personnel.
16. (-) Group identification and cohesiveness.

Consequences

1. (+) Decrement in performance output.
2. (+) Increase in errors.

3. (+) Increased time to perform tasks.
4. (+) Decrement in judgment.
5. (+) Decline in motivation to perform tasks.
6. (+) Inability to cope or adapt to uncertainty.

Sources: Bedford, 1953; Broadbent, 1953; Davis, 1953; Floyd and Welford, 1953; Glass, 1969; Kelley and Thibaut, 1969; Morgan and King, 1966; Schwab, 1953.

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